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Beyers et al.

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(54) **FILLING VALVE**

(71) Applicant: **Filmatic Packaging Systems (Pty) Ltd**, Huguenot (ZA)

(72) Inventors: **Daniel Scholtz Beyers**, Huguenot (ZA); **Johannes Albertus Loubser Beyers**, Huguenot (ZA)

(73) Assignee: **Filmatic Packaging Systems (Pty) Ltd**, Huguenot (ZA)

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(51) **Int. Cl.**
B67C 3/26 (2006.01)

(52) **U.S. Cl.**
CPC ***B67C 3/2608*** (2013.01); ***B67C 3/2611*** (2013.01); ***B67C 3/2637*** (2013.01)

(58) **Field of Classification Search**
CPC B67C 3/2608; B67C 3/2637; B67C 3/2611
USPC 251/335.3; 141/290, 291, 308, 309
See application file for complete search history.

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Primary Examiner — William McCalister
Assistant Examiner — Ian Paquette
(74) *Attorney, Agent, or Firm* — Fennemore Craig, P.C.

(57) **ABSTRACT**

The invention discloses a valve including a valve body with a valve inlet and a valve outlet. The valve body is joined to a bellows between the valve inlet and the valve outlet, the bellows having an annular side wall formed in a concertina formation with inner and outer corners wherein the side wall has a non-constant thickness along its length, the side wall being thicker at the outer corners and thinner at the inner corners. The bellows further has an annular mounting base for attachment to the valve body. The valve body has an annular flange from which extends an upstanding collar, wherein the mounting base is clamped between the valve body and the collar. The mounting base has a width being wider than a gap formed between the valve body and the collar so that the mounting base is compressed when clamped between the valve body and the collar.

21 Claims, 5 Drawing Sheets

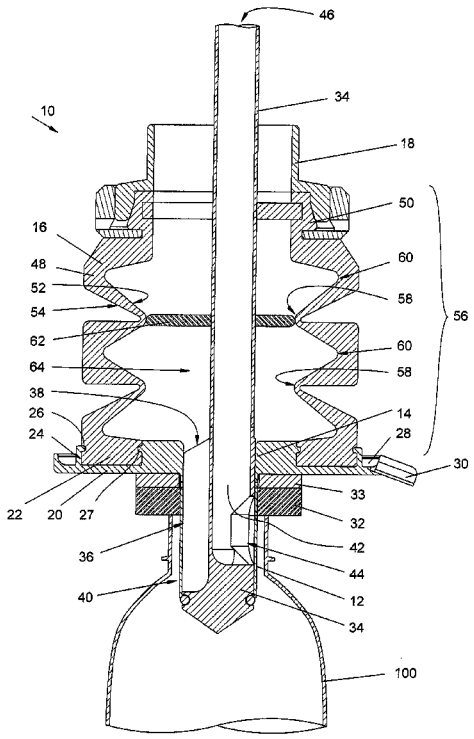

FIG. 1

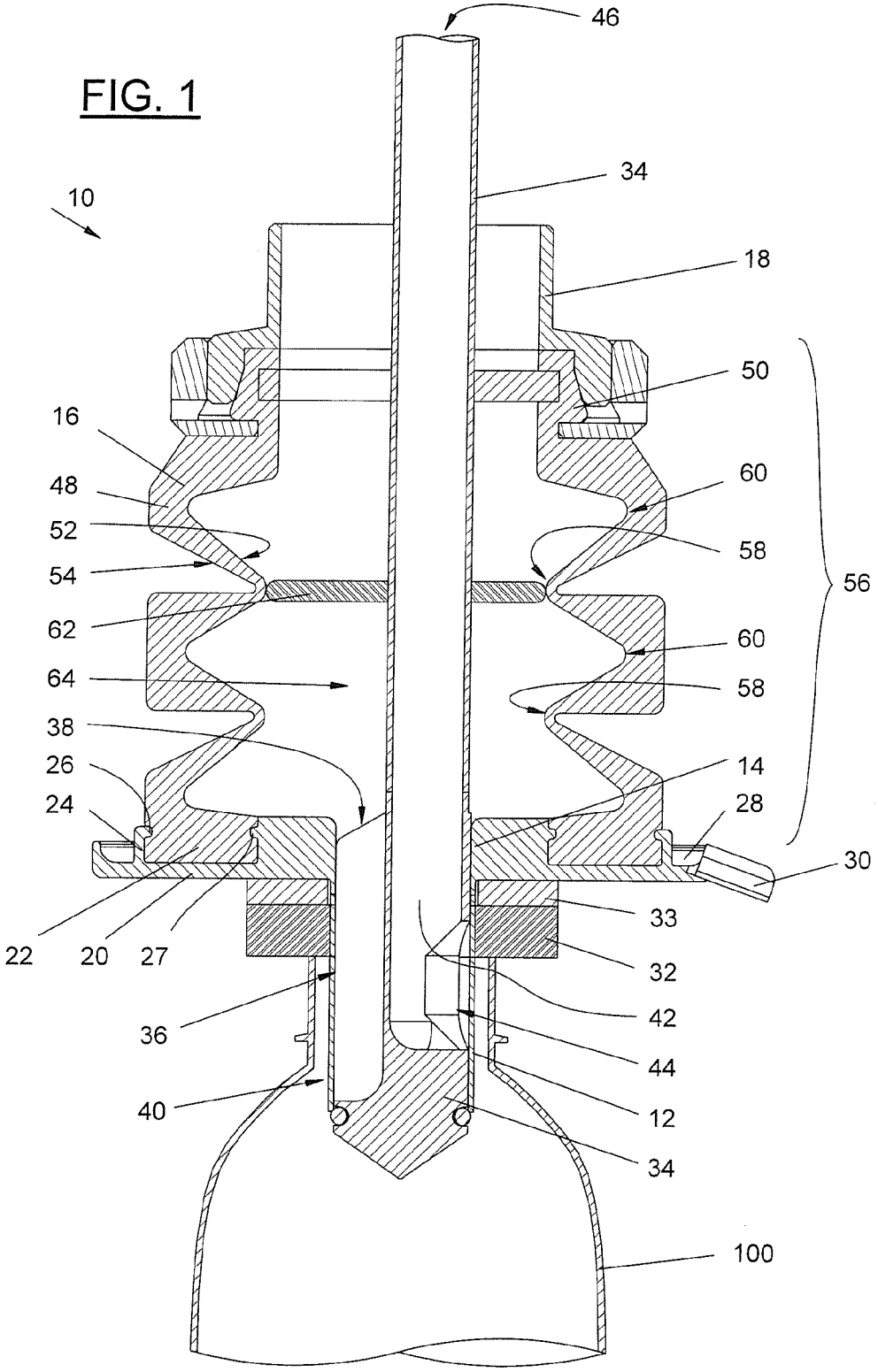
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FIG. 2

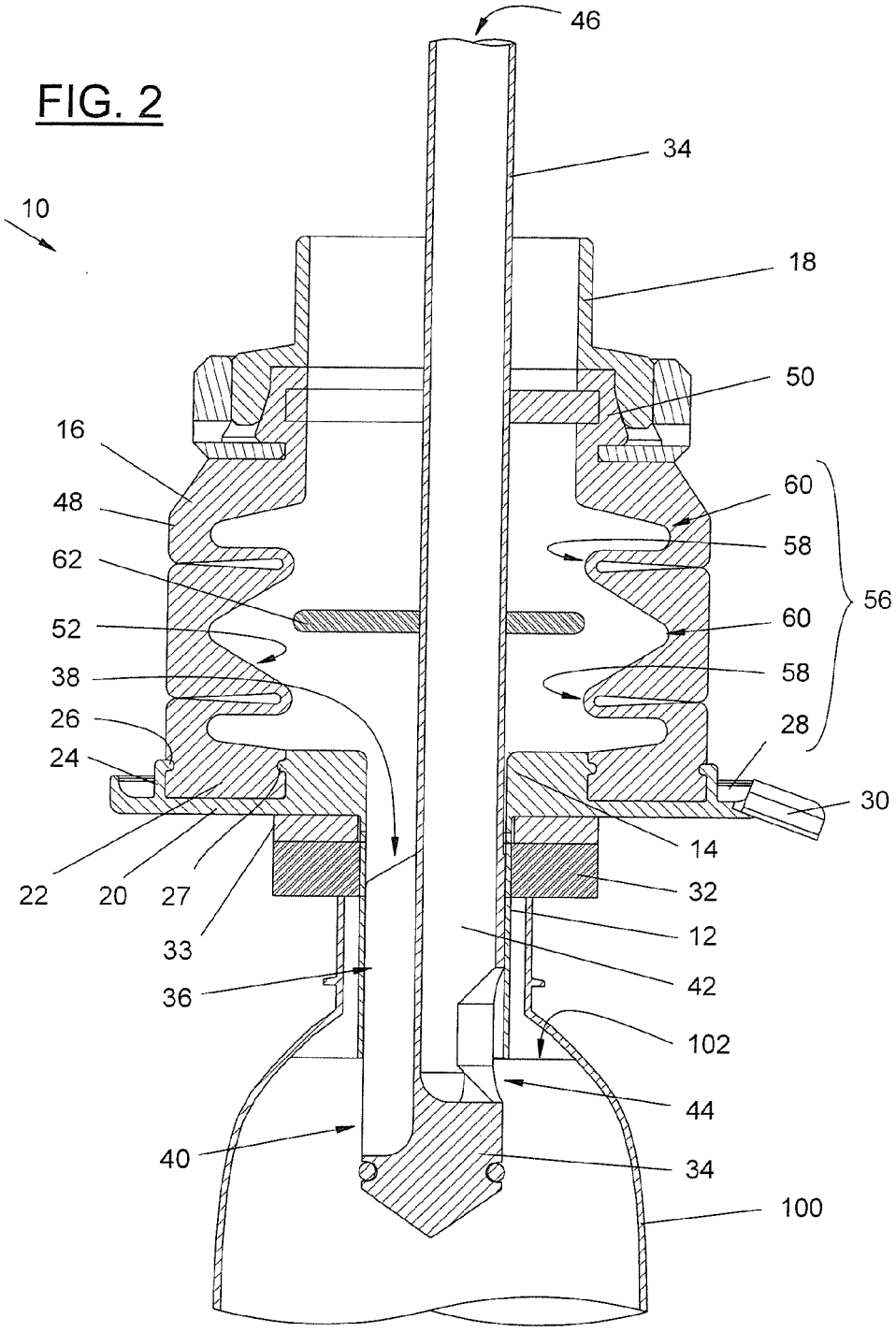
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FIG. 3

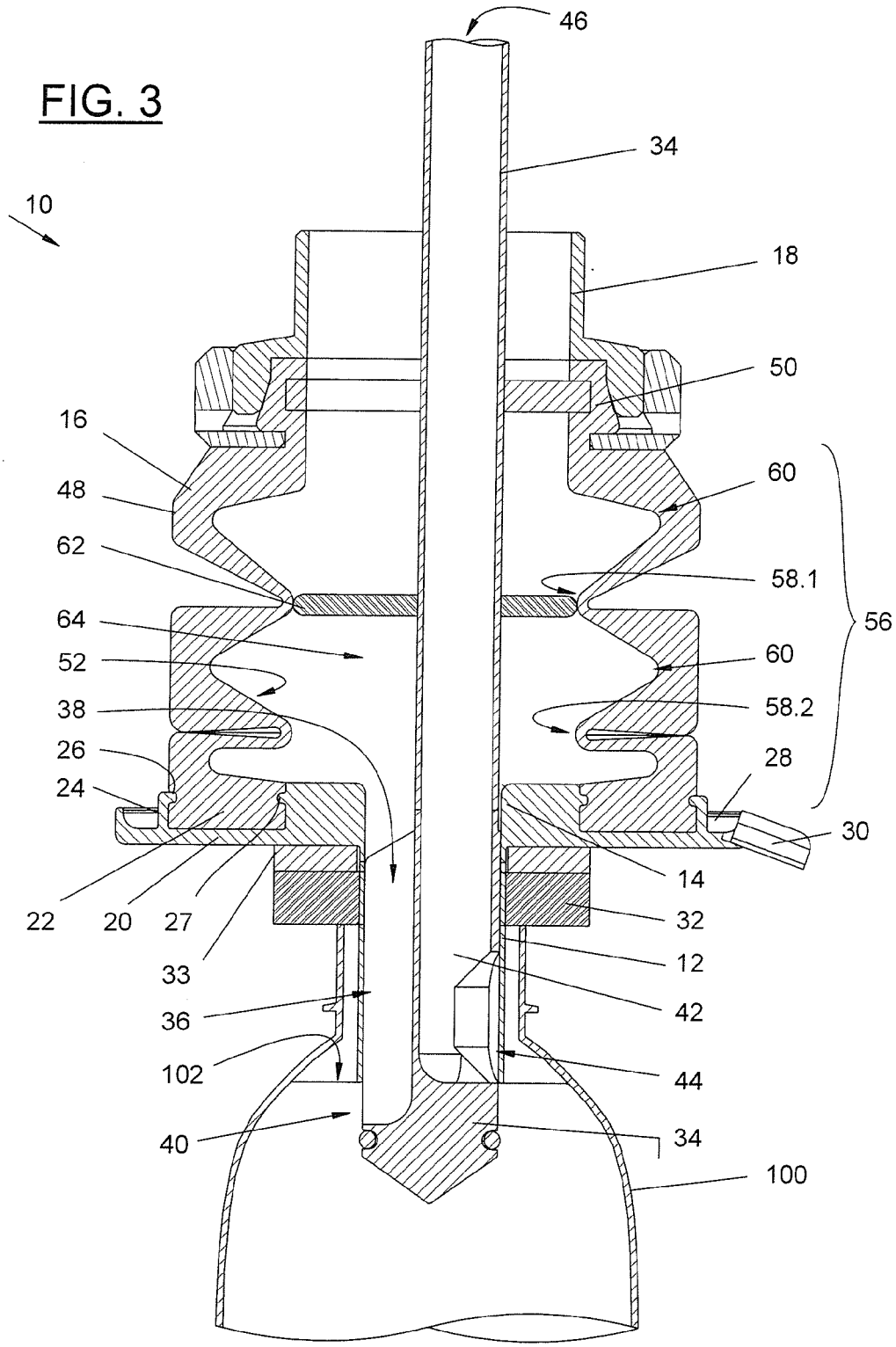
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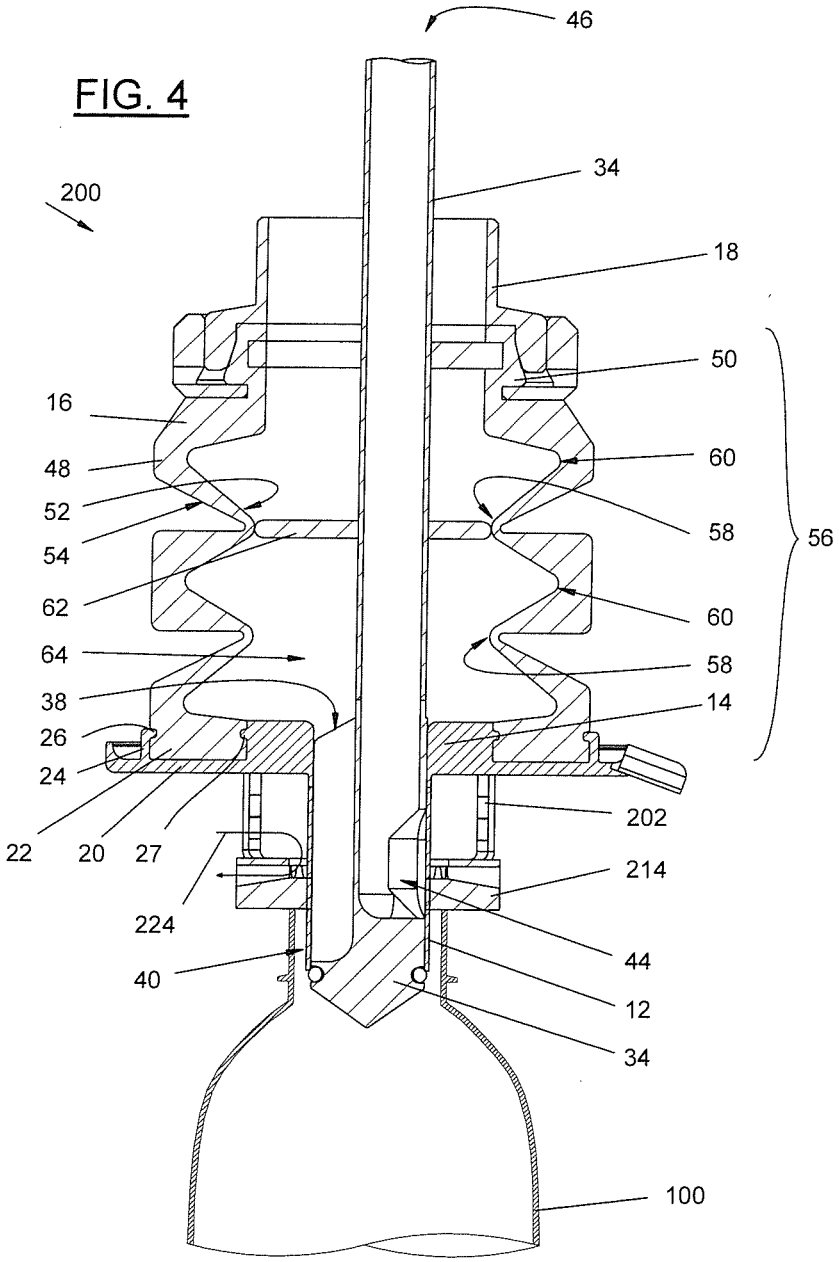
FIG. 4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214
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100

FIG. 5

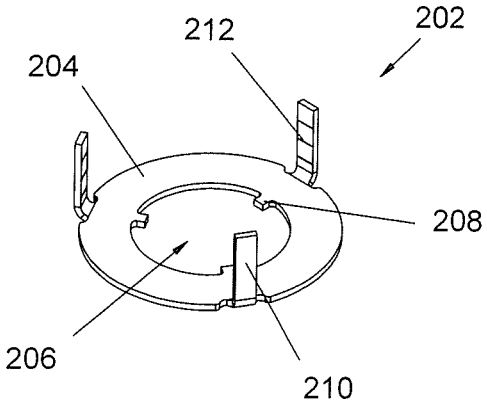
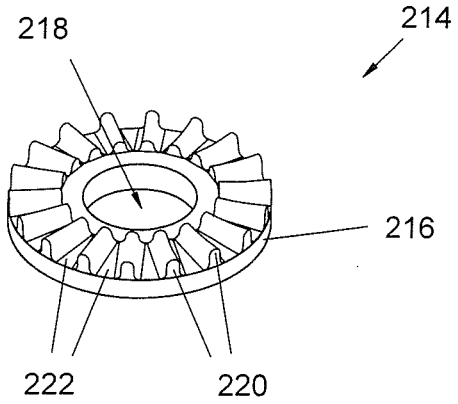


FIG. 6



FILLING VALVE

FIELD OF INVENTION

The present invention relates to a filling valve.

More particularly, the present invention relates to a filling valve for an automatic level filling machine that can be cleaned in place without requiring dismantling.

BACKGROUND TO INVENTION

An automatic level filling valve used in a rotary level filling machine allows a container to be filled with a product to a preset level. The filling valve has two concentric tubes with an outer tube surrounding an inner tube so that the outer tube can slide longitudinally along the inner tube. A first or product passage is provided for allowing product to flow into the container, which product passage can either be formed within the first inner tube or as a recess on the outer periphery of the inner tube. A second or vent passage for venting air from the container during a filling operation extends longitudinally through the inner tube.

The outer tube is joined to and supported by a compressible bellows. In a rest position of the filling valve, the outer tube is biased by the compressible bellows to close off both the product and vent passages.

During operation, when the tubes are inserted into the container, the container presses against a part of the outer tube to counteract the bias of the bellows—thereby causing the outer tube to slide along the inner tube to open the product and vent passages. This allows the product to flow through the product passage into the container while air in the container is displaced by the product and vented through the vent passage.

The level to which the container is filled is determined by the distance that the outer tube is inserted into the container. The filling operation automatically stops after the product level in the container rises sufficiently to cover and close off the vent passage, because the air in the container is trapped and can no longer be vented through the vent passage.

The pressure exerted on the product in the container at this stage is dependent on and a function of the head of fluid or liquid provided in a filling bowl above the filling valve. This pressure often results in the container volume increasing slightly because of swelling under pressure, which can be quite significant for more flexible containers. Subsequently, as the container is removed from the valve, the valve is closed and the pressure head removed from the container. This results in a "contraction" of the container when returning to its normal shape and a corresponding decrease in container volume, often leading to some of the product in the container being ejected through its mouth.

The pressure head can also cause some of the product to leak out between the outer tube and the bellows due to the product flowing through the bellows before entering the product passage.

In order to maintain hygiene, particularly when the product being filled is for consumption, the valve must be regularly cleaned. Ideally, to improve production time, the valve should be cleaned in place on the filling machine. In filling machines not having a bellows, the cleaning is done by flushing the valve with cleaning fluid in a reverse direction to the normal filling operation. However in valves with regular bellows (i.e. having a constant side wall thickness), this is not possible due to the bellows being "concertinaed" when opened. Some product is thus trapped within the folds of the bellows side wall, which prevents proper cleaning. Thus such valves need to be removed from the filling machine and dismantled to be properly cleaned.

It is an object of the invention to suggest a valve, which will assist in overcoming these problems.

SUMMARY OF INVENTION

According to the invention, a valve includes a valve body with a valve inlet and a valve outlet; a bellows being joined at one end externally to the valve body between the valve inlet and the valve outlet; wherein the bellows has an annular side wall formed in a concertina formation with inner and outer corners and wherein the side wall has a non-constant thickness along its length, the side wall being thicker at the outer corners and thinner at the inner corners.

The bellows may be adapted to be compressed during which major deformation of the concertina formation occurs at the inner corners, while restricted deformation of the concertina formation occurs at the outer corners.

The side wall may have an inner surface and wherein, during compression of the bellows, no part of the inner surface comes into contact with any other part of the inner surface.

The side wall may have a substantially rectangular shape outwardly of the outer corners when seen in vertical cross-section.

The side wall may be adapted to prevent compression of the bellows beyond a pre-selected degree.

The valve may include a plug located transversally inside the bellows, the plug being adapted to seal against the side wall when the bellows is fully expanded or partially compressed and the plug further being adapted to be spaced apart from the side wall when the bellows is compressed by more than 40%.

The plug may be a circular disc.

The plug may be adapted to seat against an inner corner of the concertina formation.

The bellows may have an annular mounting base for attachment to the valve body; and the valve body has an annular flange from which extends an upstanding collar, wherein the mounting base is clamped between the valve body and the collar.

The mounting base may have a width being wider than a gap formed between the valve body and the collar, thereby to compress the mounting base when clamped between the valve body and the collar.

The valve may include an annular gutter surrounding the bellows, the gutter being located between the bellows and the valve outlet, wherein the gutter is adapted to catch condensation or liquid from an outer surface of the bellows.

The gutter may have a discharge chute being adapted to discharge any liquid from the gutter, the discharge being remote from the valve outlet.

The valve may include a spacer having a flat disc shaped spacer body with an internal passage being adapted to receive the valve body, into which passage there projects locating pins being adapted to abut against the valve body.

A number of spaced tabs may project perpendicularly from the spacer body near to an outer peripheral edge of the spacer body.

The tabs may be etched at discrete intervals to indicate cut-lines at which the tabs are adapted to be cut for altering their height.

The valve may include a seal ring having a disc shaped ring body with an internal passage being adapted to receive the

valve body, wherein a number of ridges project from the ring body, thereby to define grooves being adapted to direct flow of liquid.

The ridges may extend radially outwardly from a centre of the ring body.

The grooves may be angled operatively downwardly towards an outer perimeter of the seal ring being adapted to direct flow of liquid accumulated therein towards the outer perimeter.

Also according to the invention, a valve includes a valve body with a valve inlet and a valve outlet; a bellows being joined at one end externally to the valve body between the valve inlet and the valve outlet, the bellows having an annular mounting base for attachment to the valve body; the valve body being provided with an annular flange from which extends an upstanding collar, wherein the mounting base is clamped between the valve body and the collar.

The mounting base may have a width being wider than a gap formed between the valve body and the collar, whereby the mounting base is adapted to be compressed when clamped between the valve body and the collar.

Further according to the invention, a valve includes a valve body with a valve inlet and a valve outlet; a bellows being joined at one end externally to the valve body between the valve inlet and the valve outlet; and an annular gutter surrounding the bellows, the gutter being located between the bellows and the valve outlet, wherein the gutter is adapted to catch condensation or liquid from an outer surface of the bellows.

The gutter may have a discharge chute being adapted to discharge any liquid from the gutter, the discharge being remote from the valve outlet.

BRIEF DESCRIPTION OF DRAWINGS

The invention will now be described by way of example with reference to the accompanying schematic drawings.

In the drawings there is shown in:

FIG. **1**: A sectional side view of a first embodiment of a filling valve according to the invention, shown in a closed position;

FIG. **2**: A sectional side view of the valve of FIG. **1** in an open position;

FIG. **3**: A sectional side view of the valve of FIG. **1** in a partially open/closed position;

FIG. **4**: A sectional side view of a second embodiment of a filling valve according to the invention, shown in a closed position;

FIG. **5**: A perspective view of a spacer provided in the valve shown in FIG. **4**; and

FIG. **6**: A perspective view of a seal ring provided in the valve shown in FIG. **4**.

DETAILED DESCRIPTION OF DRAWINGS

Referring to FIGS. **1** to **3** of the drawings there is shown a first embodiment of a filling valve in accordance with the invention being generally indicated by reference numeral **10**. The valve **10** is an automatic level filling valve, as used in rotary or in-line level filling machines for filling a container **100** with a product to a pre-selected level **102**.

The valve **10** includes an outer tube **12** which is joined at one end **14** to a resilient flexible compressible hollow bellows **16**, with the bellows **16** in turn being joined to a filling tank **18** holding a supply of the product (only the outlet of the filling tank **18** is shown in the drawings). The outer tube **12** has an annular flange **20** abutting against a base **22** of the bellows **16**, with a collar **24** projecting from the flange **20** and having a bent off end **26**. The collar **24** serves to clamp the bellows base **22** tightly against the outer tube end **14**. Preferably the bellows base **22** will have a width being slightly larger than the space between the collar **24** and the outer tube end **14** so that the bellows base **22** is slightly compressed when inserted between the collar **24** and outer tube end **14**. The tube end **14** extending into the bellows **16** can optionally have a thicker side wall than the rest of the tube **12** that is remote from the bellows **16**, so as to provide additional support for clamping the bellows base **22**. An annular ridge **27** surrounds the tube end **14** for cooperation with the bent off end **26** to secure the bellows base **22** between the collar **24** and the tube end **14**.

The flange **20** has an annular gutter **28** surrounding the collar **24** with a chute **30** leading from the gutter **28**.

A seal ring **32** is located around the outside of the outer tube **12** on a side of the flange **20** opposite to the bellows **16**. The position of the seal ring **32** on the outer tube **12** can be regulated by inserting suitable spacers **33** between the seal ring **32** and the flange **20**. The spacers **33** thereby regulate the distance that the outer tube **12** projects into the container **100** and consequently the level to which the container **100** will be filled during use.

An inner tube **34** is located within the outer tube **12** so that the outer tube **12** can slide longitudinally relative to the inner tube **34**. The inner tube **34** is fixed to be stationary relative to the filling tank **18**. The inner tube **34** has an outer diameter at its lower end that is substantially similar to the inner diameter of the outer tube **12** so that they slidingly seal against each other. The inner tube **34** defines a product passage **36** extending through the outer tube **12**, with the product passage **36** being in flow communication with the filling tank **18** so that product can flow from the filling tank **18** through the bellows **16** and through the outer tube **12** via the product passage **36**. The product passage **36** has a product inlet **38** and a product outlet **40**. Leakage of product between the bellows **16** and the outer tube **12** is limited by the tight clamp of the bellows base **22** between the collar **24** and tube end **14**.

The inner tube **34** further has a vent passage **42** extending along its length with a vent inlet **44** and a vent outlet **46**. The vent inlet **44** is located near to the product outlet **40**, while the vent outlet **46** extends beyond product in the filling tank **18** to be open to the ambient environment.

The inner tube **34** is fixed in position relative to the filling tank **18** while the outer tube **12** is adapted to be biased by the bellows **16** to close off the product outlet **40** and the vent inlet **44** of the inner tube **34**.

During dispensing use, the container **100** is located beneath the valve **10** so that the outer tube **12** projects into the container **100** while the container mouth contacts against the seal ring **32**. By moving the container **100** and valve **10** towards each other, the container **100** presses against the seal ring **32** to overcome the bias of the bellows **16**, thereby compressing the bellows **16** and causing the outer tube **12** to slide (upwardly in the drawings) along the inner tube **34** to consecutively open both the product outlet **40** and the vent inlet **44**, as is illustrated in FIG. **2**. While the container **100** is filled, air inside the container **100** is displaced and exhausted through the vent passage **42**. The filling operation stops automatically after the product level **102** in the container **100** reaches the base of the outer tube **12**. This is due to the product covering the vent inlet **44**, preventing air in the container **100** from exiting through the vent passage **42**, and the resultant pressure increase inside the container **100**. The container **100** is subsequently lowered, allowing expansion of the bellows **16** to again bias the outer tube **12** to close off the product outlet **40**

and the vent inlet **44** of the inner tube **34**, as illustrated in FIG. **1**, whereafter the container **100** can be replaced by a fresh container for filling.

The bellows **16** has a side wall **48** extending axially from the bellows base **22** and also, distal to the bellows base **22**, a mounting rim **50** for attachment of the bellows **16** to the filling tank **18**. The side wall **48** has an inner surface **52** and an outer surface **54**. A number of concertina formations **56** are formed in the side wall **48** with the concertina formations **56** having annular inner corners **58** and annular outer corners **60**. The side wall **48** has a varying thickness along the concertina formations **56** so that the side wall **48** is thinner at its inner corners **58** and thicker at its outer corners **60**. The varying thickness serves to strengthen and support the outer corners **60** so that they substantially retain their shape when the bellows **16** is fully compressed, while the necessary deformation required to permit compression of the bellows **16** occurs primarily at the inner corners **58**. By focusing the location of the deformation in this way at the inner corners **58**, the inner surface **52** of the side wall **48** remains "open" and accessible to prevent any product from being trapped within folds of the compressed concertina formation **56**.

A further advantage of the variable side wall thickness of the concertina formation **56** is that the valve **10** can be cleaned in place without the need for removal from the filling machine or dismantling. During a washing cycle the valve **10** is opened and reverse flushed with cleaning fluid, i.e. the cleaning fluid enters through the product outlet **40** and vent inlet **44** and exits into the filling tank **18** and through the vent outlet **46**. Due to the inner surface **52** of the bellows **16** remaining fully open and in communication with the flow path of the cleaning fluid, the cleaning fluid is able to come into contact with the entire inner surface **52** of the bellows **16** and also the inside of the vent tube **42**.

The strengthened outer corners **60** abut solidly against each other while the bellows **16** is compressed. This prevents further compression of the bellows **16** in a cleaning cycle due to the high pressure of the reverse flowing cleaning fluid and the associated leaking of cleaning fluid at the seal ring **32**.

The valve **10** also includes a plug **62** in the form of a circular disc joined to the inner tube **34** within the bellows **16**. The plug **62** located on the inner tube **34** at a position whereby the plug **62** is aligned with and seals against the side wall **48** at one of the inner corners **58.1** of the concertina formation **56** when the valve **10** is closed or only partially open (as shown in FIG. **3**). The plug **62** thus divides the cavity within the bellows **16** to form a smaller chamber **64** within the bellows **16** between the plug **62** and the bellows base **22**. When the valve **10** is fully opened, as shown in FIG. **2**, the plug **62** is moved away from the corner **58.1** to be spaced apart from the side wall **48**.

The side wall **48** can be manufactured to be stronger along the inner corner **58.1** and weaker along the inner corner **58.2** (see FIG. **3**), which can be achieved by making the side wall **48** slightly thicker along the inner corner **58.1** in relation to the inner corner **58.2**. During opening compression of the bellows **16**, the side wall **48** will thus initially deform and collapse along the inner corner **58.2** and only thereafter will deformation and collapsing occur along the inner corner **58.1** as is illustrated in FIG. **3**. Conversely, during closing expansion of the bellows **16**, the side wall **48** will first regain its original shape along the inner corner **58.1** before doing so at inner corner **58.2**.

The plug **62** does not contact or seal with the side wall **48** while it is deformed along the inner corner **58.1**.

While the bellows **16** is only partially compressed with deformation of the side wall **48** only occurring along inner corner **58.2**, the vent inlet **44** remains closed by the outer tube **12**. The vent inlet **44** is only open while the side wall **48** is deformed along inner corner **58.1**.

In use, when the valve **10** is open and the bellows **16** is compressed, the product can flow around the plug **62** through the bellows **16**. After the filling operation has stopped the container is lowered away from the valve **10** allowing the bellows **16** to expand. The initial expansion along corner **58.1** causes the plug **62** to seal against the side wall **48** while simultaneously closing off chamber **64** from the filling tank **18**. Subsequent further expansion of the bellows **16** along inner corner **58.2** results in an increase in the volume of the chamber **64** and accordingly forming a low pressure therein. This low pressure causes a suction and a small volume of product flows back from the container **100** through the product passage **36** into the chamber **64** before outlet tube **12** closes off vent inlet **44**. The volume of product thus taken from the container **100** is not sufficiently large to incorrectly fill the container, but is sufficient to remove any excess product that would otherwise overflow from the container **100** when it resumes its normal shape after reversal of the swelling caused by the head liquid pressure of the filling tank **18**.

Often the product being filled through the valve **10** is cooler than ambient temperature, which causes condensation on the outer surface **54** of the bellows **16**. This condensation may contain impurities and germs and can form droplets that run down the bellows **16** and drip off the outer tube **12** into the container as the container is being moved into position under the valve **10** before filling or before it is moved away after filling. The gutter **28** collects any such condensation, which is then safely conveyed away via the chute **30**.

Referring now to FIGS. **4** to **6** of the drawings there is shown a second embodiment of a filling valve in accordance with the invention being generally indicated by reference numeral **200**. The valve **200** is substantially the same as the valve **10** and similar parts are indicated by the same reference numerals.

The valve **200** has a spacer **202**, which is also shown in greater detail in FIG. **5**, in lieu of the spacers **33**. The spacer **202** has a flat disc shaped body **204** with a passage **206** for receiving the outer tube **12**. Locating pins **208** project inwardly into the passage **206** from the body **204** to abut against the outer tube **12** and to centrally locate the outer tube **12** in the passage **206**.

Three equidistantly spaced tabs **210** extend from the outer peripheral edge of the body **204**. The tabs **210** are bent substantially perpendicularly to the body **204** and are adapted to abut against the flange **20**. The tabs **210** are etched **212** at discrete intervals to indicate cut-lines at which the tabs **210** can be cut for altering the height of the spacer **202**.

The valve **200** further has a seal ring **214**, which is also shown in greater detail in FIG. **6**, in lieu of the seal ring **32**. The seal ring **214** has a disc shaped body **216** with a passage **218** for receiving the outer tube **12**. The seal ring **214** has a number of radially extending ridges **220** and grooves **222** on its upper surface being adapted to abut against the spacer **202** in situ. The grooves **222** are angled downwardly towards the outer perimeter of the seal ring **214** so as to direct flow of liquid accumulated therein away from the outer tube **12**.

The tabs **210** and locating pins **208** of the spacer **202** cooperate with the grooves **222** of the sealing ring **214** to form a drain passage (indicated by arrow **224** in FIG. **4**) for cleaning liquid during a cleaning cycle.

The invention claimed is:

1. A valve including a valve body with a valve inlet and a valve outlet; a bellows being joined at one end externally to the valve body between the valve inlet and the valve outlet; a

plug located transversally inside the bellows, wherein the bellows has an annular side wall formed in a concertina formation with inner and outer corners and wherein the side wall has a non-constant thickness along its length, the side wall being thicker at the outer corners and thinner at the inner corners, the plug being adapted to seal against the side wall when the bellows is fully expanded or partially compressed, the plug further being adapted to be spaced apart from the side wall when the bellows is compressed by more than 40%.

2. A valve as claimed in claim **1**, in which the bellows is adapted to be compressed during which major deformation of the concertina formation occurs at the inner corners, while restricted deformation of the concertina formation occurs at the outer corners.

3. A valve as claimed in claim **1**, in which the side wall has an inner surface and wherein, during compression of the bellows, no part of the inner surface comes into contact with any other part of the inner surface.

4. A valve as claimed in claim **1**, in which the side wall has a substantially rectangular shape outwardly of the outer corners when seen in vertical cross-section.

5. A valve as claimed in claim **1**, in which the side wall is adapted to prevent compression of the bellows beyond a pre-selected degree.

6. A valve as claimed in claim **1**, in which the plug is a circular disc.

7. A valve as claimed in claim **1**, in which the plug is adapted to seat against an inner corner of the concertina formation.

8. A valve as claimed in claim **1**, in which the bellows has an annular mounting base for attachment to the valve body; and the valve body has an annular flange from which extends an upstanding collar, wherein the mounting base is clamped between the valve body and the collar.

9. A valve as claimed in claim **8**, in which the mounting base has a width being wider than a gap formed between the valve body and the collar, thereby to compress the mounting base when clamped between the valve body and the collar.

10. A valve as claimed in claim **1**, which includes an annular gutter surrounding the bellows, the gutter being located between the bellows and the valve outlet, wherein the gutter is adapted to catch condensation or liquid from an outer surface of the bellows.

11. A valve as claimed in claim **10**, in which the gutter has a discharge chute being adapted to discharge any liquid from the gutter, the discharge being remote from the valve outlet.

12. A valve as claimed in claim **1**, which includes a seal ring having a disc shaped ring body with an internal passage being adapted to receive the valve body, wherein a number of ridges project from the ring body, thereby to define grooves being adapted to direct flow of liquid.

13. A valve as claimed in claim **12**, in which the ridges extend radially outwardly from a centre of the ring body.

14. A valve as claimed in claim **12**, in which the grooves are angled operatively downwardly towards an outer perimeter of the seal ring being adapted to direct flow of liquid accumulated therein towards the outer perimeter.

15. A valve as claimed in claim **1**, which includes a spacer having a flat disc shaped spacer body with an internal passage being adapted to receive the valve body, into which passage there projects locating pins being adapted to abut against the valve body.

16. A valve as claimed in claim **15**, in which a number of spaced tabs project perpendicularly from the spacer body near to an outer peripheral edge of the spacer body.

17. A valve spacer as claimed in claim **16**, in which the tabs are etched at discrete intervals to indicate cut-lines at which the tabs are adapted to be cut for altering their height.

18. A valve including a valve body with a valve inlet and a valve outlet; a bellows being joined at one end externally to the valve body between the valve inlet and the valve outlet; a plug located transversally inside the bellows, the bellows having an annular mounting base for attachment to the valve body; the valve body being provided with an annular flange from which extends an upstanding collar, wherein the mounting base is clamped between the valve body and the collar, the plug being adapted to seal against a side wall of the bellows when the bellows is fully expanded or partially compressed, the plug further being adapted to be spaced apart from the side wall of the bellows when the bellows is compressed by more than 40%.

19. A valve as claimed in claim **18**, in which the mounting base has a width being wider than a gap formed between the valve body and the collar, whereby the mounting base is adapted to be compressed when clamped between the valve body and the collar.

20. A valve including a valve body with a valve inlet and a valve outlet; a bellows being joined at one end externally to the valve body between the valve inlet and the valve outlet; a plug located transversally inside the bellows; and an annular gutter surrounding the bellows, the gutter being located between the bellows and the valve outlet, wherein the gutter is adapted to catch condensation or liquid from an outer surface of the bellows, the plug being adapted to seal against a side wall of the bellows when the bellows is fully expanded or partially compressed, the plug further being adapted to be spaced apart from the side wall of the bellows when the bellows is compressed by more than 40%.

21. A valve as claimed in claim **20**, in which the gutter has a discharge chute being adapted to discharge any liquid from the gutter, the discharge being remote from the valve outlet.

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